Deep-Reinforcement-Learning-Based Autonomous Voltage Control for Power Grid Operations

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Abstract

In this letter, a novel autonomous control framework “Grid Mind” is proposed for the secure operation of power grids based on cutting-edge artificial intelligence (AI) technologies. The proposed platform provides a data-driven, model-free and closed-loop control agent trained using deep reinforcement learning (DRL) algorithms by interacting with massive simulations and/or real environment of a power grid. The proposed agent learns from scratch to master the power grid voltage control problem purely from data. It can make autonomous voltage control (AVC) strategies to support grid operators in making effective and timely control actions, according to the current system conditions detected by real-time measurements from supervisory control and data acquisition (SCADA) or phasor measurement units (PMUs). Two state-of-the-art DRL algorithms, namely deep Q-network (DQN) and deep deterministic policy gradient (DDPG), are proposed to formulate the AVC problem with performance compared. Case studies on a realistic 200-bus test system demonstrate the effectiveness and promising performance of the proposed framework.